2.—Some microplankton from two bores at Balcatta, Western Australia

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Abstract

Eleven dinoflagellate species and one acritarch are described from the Osborne Formation, of Albian-Cenomanian age, in the Perth Basin of Western Australia. Two new genera, *Conosphaeridium* (type species: *Hystrichosphaeridium striatoconus* Deflandre and Cookson) and *Xenascus* (type species: *Xenascus australense* Cookson and Eisenack n.sp.) are proposed. The following new species are instituted: *Deflandrea glabra*, *Deflandrea balcattensis*, *Xenascus australense* and *Conosphaeridium tubulosum*.

Introduction

This paper is concerned with a few of the many types of microplankton present in some samples of the upper portion of the Osborne Formation from two bores sunk by the Perth Metropolitan Water Supply at Balcatta, about 8 miles north of Perth, Western Australia. Balcatta Bore No. 1, which reached a total depth of 2,500 feet, was drilled near the junction of Albert Street and Ronald Street; Balcatta Bore No. 2, which reached a depth of 2,401 feet, was drilled near the intersection of Albert Street and North Beach Road. The Osborne formation is regarded as of Albian-Cenomanian Age (McWhae *et al* 1958 p. 143). The succession in these boreholes (depths in feet) is as follows:

Balcatta No. 1		Balcatta No. 2
0 - 110	Quaternary Sand	0 - 107
110 - 520	Osborne Formation	107 - 510
520 - 2000	South Perth Formation	510 - 1810
2000 - 2500	Yarragadee Formation	1810 - 2401 T.D.

We are indebted to Mr. J. H. Lord, Director of the Geological Survey of Western Australia and Dr. B. E. Balme, University of Western Australia for the gift of samples and Dr. A. E. Cockbain for information regarding the locality and age of the deposits concerned.

The holotypes will be housed in the palaeontological collection of the Geological Survey of Western Australia. Numbers prefaced by the letter F are registered numbers in that collection.

Systematic descriptions

Dinoflagellata

Family *DEFLANDREACEAE* Eisenack

Genus *Deflandrea* Eisenack 1938

Deflandrea glabra n.sp.

(Figure 1,A holotype F6629)

Occurrence. Balcatta Bore No. 1, between 220-227 feet, and 240 feet, Bore No. 2 at 220 feet.

Description. Shell considerably longer than broad with convex sides that slant towards both apex and antapex. The apex ends in a short and bluntly pointed horn; the antapex is truncate or slightly concave with a sharply pointed horn on one side. There is no indication of tabulation, girdle or longitudinal furrow. Both the outer wall and that of the capsule are thin and smooth. The capsule is spherical in outline and does not extend to the lateral walls. The archeopyle is relatively large, trapezoidal with rounded corners.

Dimensions. Holotype-length 95 μ width 52 μ Range-length about 95-142 μ width about 52-82 μ.

Comment. The shape of *D. glagra* is close to that of *D. belfastensis* Cookson and Eisenack 1961 from an Upper Cretaceous deposit in the Belfast North Bore in S.W. Victoria, between 4645 and 4652 feet. However the wall of *D. belfastensis* is prominently granular, whereas that of *D. glabra* is smooth.

Deflandrea balcattensis n. sp.

(Figure 1, B-F, holotype Figure 1,B, F6630)

Occurrence. Balcatta Bore No. 1, 120-160 feet, 230-270 feet. Balcatta Bore No. 2 at 150 and 200 feet.

Description. Shell smooth, rather flat, roughly oval in outline divided unequally by a relatively broad, deep girdle the hypotheca being shorter than the epitheca. The sides of the epitheca, which are convex, narrow distally towards a short truncate apex. The wall of the hypotheca narrows gradually, one side usually being longer and somewhat convex, the other shorter and slightly oblique, so that the antapex is situated, more or less, to one side of the mid-line. An archeopyle has not been evident. A characteristic feature of the ventral surface has been the constant presence, in the mid-line just below the lower limits of the girdle, of a short, wavy, longitudinal thickening (Fig. 1 E, F) closely similar to that associated with the flagellum in some living dinoflagellates. The capsule, which is well defined and approximately spherical, does not quite fill the shell laterally. Its wall is smooth, unornamented, and relatively thick.

Dimensions. Holotype—overall length 72 μ, overall width 52 μ, capsule about 38 x 42 μ. Range—overall length about 55-72 μ, overall width about 38-52 μ.

Comment. D. balcattensis is obviously closely related to *D. rotundata* Eisenack and Cookson 1960, from an Albian deposit in the Oodnadatta Bore, South Australia, at 3221 feet and *D. foliacea* Eisenack and Cookson 1960 from Upper Cretaceous deposits such as the Upper Gearle Siltstone and the Molecap Greensand in Western Australia. In both, as in *D. balcattensis*, an *archeopyle* is apparently not developed, a feature which casts some doubt as to their close affinity with the genus *Deflandrea*. In neither *D. rotundata* nor *D. foliacea* has the small wavy thickening, invariably present on the mid-ventral surface of *D. balcattensis*, been evident.

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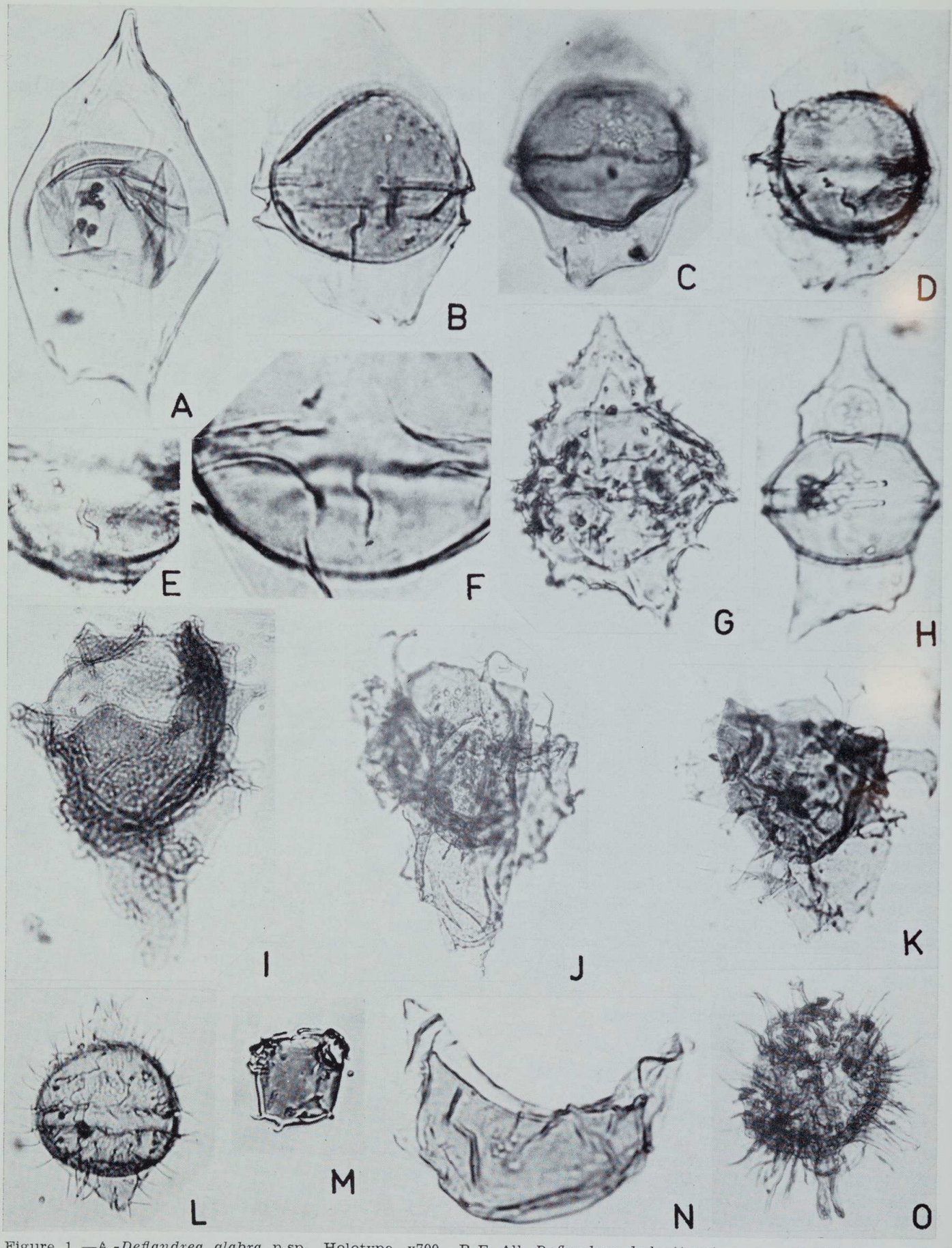

Figure 1..—A.-*Deflandrea glabra* n.sp. Holotype, x700. B-F.-All *Deflandrea balcattensis* n.sp. B.-Holotype, x700. C.-Dorsal surface of paratype, x700. D-F.-Ventral surfaces showing flagellum-like structures D.- x640. E.- x1000. F.- x1500. G-*Deflandrea* cf. *echinoidea* Cookson and Eisenack, x700. H.-*Deflandrea tripartita* Cookson and Eisenack. x500 I-K.-*Xenascus australense* n.sp., J holotype, I and K paratypes, all x400. L.-*Palaeohystrichophora infusorioides* Deflandre, x500. M.-*Gillinea hymenophora* Cookson and Eisenack, x500. N.-*Diplotesta luna* Cookson and Eisenack, x700. O.-*Coronifera oceanica* Cookson and Eisenack, x450.

Such a feature has been recorded as present in several Australian Tertiary species (Cookson and Eisenack 1965 pp. 134, 140). *D. balcattensis* also bears some resemblance to *D. perlucida* Alberti (1959, pl. 9, fig. 6, 7) from a German Upper Barremian deposit.

Deflandrea cf. echinoidea Cookson and Eisenack 1960

(Figure 1,G)

Deflandrea echinoidea Cookson and Eisenack 1960, p.2, pl. 1, fig. 5, 6.

Occurrence: Balcatta Bore No. 1, samples between 120-200 feet, 120-160 feet and 170 feet, and Bore No. 2 at 150 feet.

Dimensions. Length 50-70 μ, width 33-47 μ.

Comment. The form of *Deflandrea* which herein is compared with rather than assigned to *D. echinoidea* is not uncommon in the Mid-Cretaceous deposits referred to above. It differs from the Upper Cretaceous figured specimens from the Gingin and Toolonga areas, Western Australia, in the smaller size-range, the coarser and more sparsely arranged spines and to some extent the shape of the whole shell. However, since *D. echinoidea* is the only definitely spiny *Deflandrea* so far described we have refrained from treating the Balcatta form as a new species.

Deflandrea tripartita Cookson and Eisenack 1960

(Figure 1,H)

Deflandrea tripartita Cookson and Eisenack 1960, p.2, pl. 1, fig. 10.

Occurrence. Balcatta No. 1 bore, at 170 and 180-210 feet.

Comment. Several examples similar to the one on Figure 1, H have been recovered from the Balcatta Bore No. 1 at 170 and 180-200 feet (B. E. Balme sample 14800). The surface of the shell is perfectly smooth, in contrast to the slightly and finely granular surface of the type specimen from the seismic shot hole, north of Gingin, at 160 feet.

Genus *Palaeohystrichophora* Deflandre 1934

emend. Deflandre and Cookson 1955

Palaeohystrichophora infusorioides Deflandre 1936

(Figure 1,L)

Palaeohystrichophora infusorioides Deflandre 1936, p.38, pl. 9, fig. 8.

Palaeohystrichophora infusorioides Defl. Cookson and Eisenack 1958, p.37, pl. 10, fig. 10.

Palaeohystrichophora infusorioides Defl. Cookson and Hughes 1964, p.43, pl. 5, fig. 8.

Comment. P. infusorioides has occurred occasionally in preparations of the Balcatta No. 1 Bore at 170 feet. It was earlier recorded by Cookson and Eisenack (1958) from the Western Australian Upper Cretaceous (Cenomanian to Lower Turonian) Gearle Siltstone, Wapet's Rough Range Well No. 8 at 1530-48 and Well No. 5 at 1570 feet.

Family *STEPHODINIACEAE* Eisenack

Genus *Stephodinium* Deflandre 1936

Stephodinium australicum Cookson and Eisenack 1962

Stephodinium australicum Cookson and Eisenack 1962, p.491, pl. 2, figs. 5-10.

Occurrence. Balcatta Bore No. 1 180-210 feet B. E. Balme, Sample 1480.

Comment. Only one poorly preserved example of *S. australicum* has been found during this study. This form was previously recorded by Cookson and Eisenack from several Western Australian Mid-Cretaceous, Upper Albian to Cenomanian deposits.

Family *HYSTRICHOSPHAERIDIACEAE* Evitt

Genus *Conosphaeridium* n. gen.

Description: Shell circular in outline with a single-layered wall of varying thickness and about 20 regularly distributed conical to cylindrical, striated appendages; archeopyle circular to polygonal.

Comment: The genus *Conosphaeridium* can be distinguished from all previously described members of the Hystrichosphaeridiaceae by the single-layered wall and the absence from the appendages of trumpet or funnel-shaped terminal expansions. In particular it differs from the genus *Lithosphaeridium* in the greater number of appendages.

Type species. Conosphaeridium striatoconus (Deflandre and Cookson) new combination.

Conosphaeridium striatoconus (Deflandre and Cookson)

Figure 2A-D

Hystrichosphaeridium striatoconus Deflandre and Cookson 1955, p.275, pl. 2, fig. 10, Fig. 36.

Occurrence. Gingin W.A., Molecap Hill, Lower Greensand, Balcatta Bore No. 1 between 120 and 160 feet, 220-270 feet Bore No. 2 at 200 feet.

Comments The Balcatta examples herein referred to *C. striatoconus* whilst having the general features of the figured paratype (Deflandre and Cookson 1955, pl. 2, fig. 10) have shown considerable variation in both size and shape of the appendages. However until more examples become available it seems better to broaden the species rather than to create a new one. One feature which still remains doubtful in this species is whether the apices of the appendages are normally open or shut. In the original description it was stated that the apex is "normally closed but is frequently broken off leaving a distinct opening into the process". On the basis of size of appendages we have distinguished two deviants (a) and (b) from one that comes close to the original examples.

Size of appendages. Typical form, Figure 2B, width 21-22 μ, length 18-20 μ. Form (a), Figure 2A, width 18-22 μ, length 12-17 μ. Form (b), Figure 2C, width 20-33 μ, length 20-30 μ.

Conosphaeridium tubulosum n. sp.

(Figure 2 E, F; holotype Figure 2F, F 2231)

Occurrence: Balcatta Bore No. 1, 180-210 feet, B. E. Balme Sample 1480.

Description. Shell apparently circular in outline with relatively long, cylindrical to somewhat conical appendages with straight or slightly oblique openings, the edges of which are somewhat crenulate or serrate. The walls of the appendages are longitudinally striated, the thickenings frequently extending along the whole length of the wall. The wall of the shell is moderately thin, unpatterned and readily crushable.

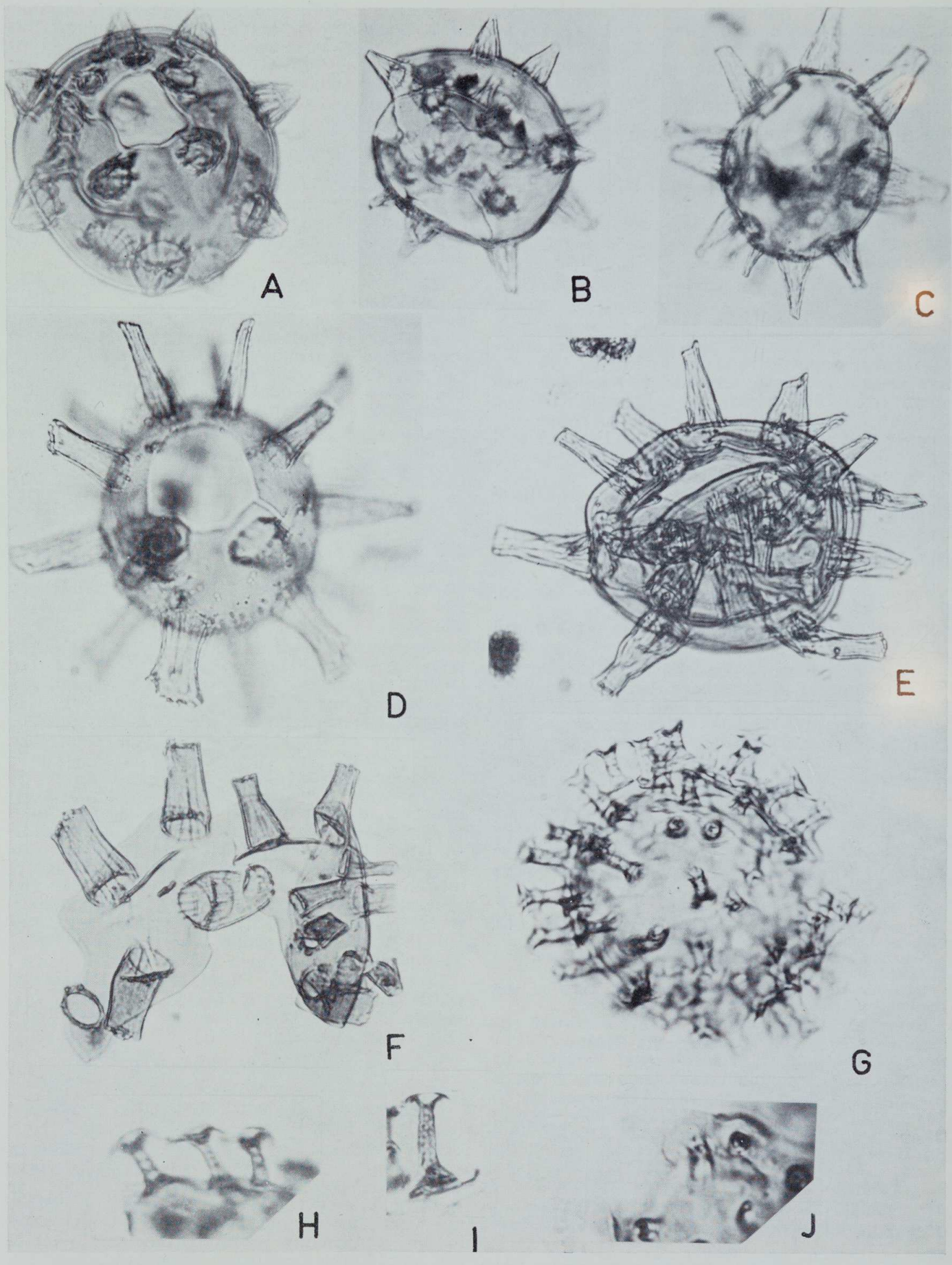

Figure 2.—A.-*Conosphaeridium* cf. *striatoconus*, x450. B-D.-*Conosphaeridium striatoconus* (Deflandre and Cookson), B and C, x350. D, x500. E and F.-*Conosphaeridium tubulosum* n.sp. E.-Holotype, x500. F.-Paratype, x500. G-J.-*Cleistosphaeridium ancoriferum* (Cookson and Eisenack). G.-x1100. H-J.-Appendages showing detailed structure, x1500.

Dimensions. Holotype: diameter of shell about 70 μ, overall diameter about 130 μ, appendages about 28-30 μ long, 8-10 μ wide. Range of appendages about 25-30 μ long.

Comment. *C. tubulosum* differs from *C. striatoconus* in both the shape and size of the appendages. In *C. striatoconus* they are relatively short and conical whereas in *C. tubulosum* they are relatively long, cylindrical or only slightly conical.

Genus *Cleistosphaeridium* Davey, Downie, Sarjeant and Williams 1966.

Cleistosphaeridium ancoriferum (Cookson and Eisenack)

(Figure 2, G-J)

Hystrichosphaeridium ancoriferum Cookson and Eisenack 1960, p. 8, pl. 2, fig. 11.

Hystrichosphaeridium ancoriferum Cookson and Eisenack; Cookson and Hughes 1964, p. 47, pl. 9, fig. 7.

Cleistosphaeridium ancoriferum (Cookson and Eisenack) Davey, Downie, Sarjeant and Williams 1966, p.167, pl. 6, fig. 5, pl. 9, fig. 1.

Cleistosphaeridium ancoriferum (Cookson and Eisenack) 1968.

Age and occurrence. Probably Albian, Balcatta Bore No. 1 at 219, 280 and 290 feet, and Bore 2 at 220 feet.

Comment. The specimens from the Balcatta Bores 1 and 2 agree completely with those of *C. ancoriferum* from the Gingin Brook Bore 4 between 402 and 404 feet (Cookson and Eisenack 1968). They further support the doubt therein expressed regarding the reference to this species of some Albian specimens from Surrey, England (Davey, Downie, Sarjeant and Williams 1966, p. 167).

Family Uncertain

Genus *Coronifera* Cookson and Eisenack 1958

(Figue 1,O)

Coronifera oceanica Cookson and Eisenack 1958, p.45, pl. 12, fig. 6.

Coronifera oceanica Cookson and Eisenack; Cookson and Hughes 1964, p. 56, pl. 9, figs. 8, 9.

Coronifera oceanica Cookson and Eisenack; Clarke and Verdier 1967, p. 77, pl. 17, fig. 7.

Coronifera oceanica Cookson and Eisenack 1968.

Comment. *C. oceanica* has occurred occasionally in the Balcatta No. 1 Bore at 120 and 170 feet. The shape of the antapical horn differs somewhat from that of the type and of an example recently recovered from Gingin Brook Bore 4, core 2, at 404-414 feet and a small horn-like structure is present at the apex.

Genus *Gillinia* Cookson and Eisenack 1960

Gillinia hymenophora Cookson and Eisenack 1960

(Figure 1,M)

Gillinia hymenophora Cookson and Eisenack 1960, p. 11, pl. 3, figs. 4-6.

Comment. *G. hymenophora*, originally described and recorded from a relatively large number of Western Australian Upper Cretaceous deposits (Senonian to Turonian), has occurred in Balcatta No. 1 bore at 170 feet.

Genus *Xenascus* n. gen.

Description. Shell consisting of a relatively thick-walled central body circular to slightly oval in outline, and a thinner, completely separate investing layer, the space between which being widest in the anatapical region. The outer layer bears appendages of variable size and shape. A large apical archeopyle, somewhat angular in outline, is developed.

Type species. *Xenascus australense* n.sp.

Xenascus australense n.sp.

(Figure 1,I-K; holotype Figure 1,J, F6632)

Occurrence. Balcatta No. 1 Bore at 170 and 180-210 feet.

Description. As for the genus. Both the inner and outer layers of the shell are finely and closely granular. The appendages vary both in number and size in individual specimens, some are simple, others forked, but all have somewhat flattened apices.

Dimensions: Holotype—overall length about 142 μ, overall width about 100 μ, central body about 76 x 68 μ. Range—overall length about 109-156 μ, overall width about 76-133 μ, central body about 70-76 μ long, about 68-76 μ broad.

Acritarcha Evitt

Subgroup Dinemorphitae Downie, Evitt and Sarjeant 1963

(= Diplotestidae Cookson and Eisenack 1960 (pars.))

Genus *Diplotesta* Cookson and Eisenack 1960a *Diplotesta luna* Cookson and Eisenack 1960b

(Figure 1, N)

Diplotesta luna Cookson and Eisenack 1960b, p. 10, Pl. 3, fig. 21.

Diplotesta luna Cookson and Eisenack 1962, p. 497, pl. 4, fig. 18, 19.)

Diplotesta luna Cookson and Eisenack; Manum and Cookson, 1964, p. 26, Pl. 5, fig. 9.

Comment. *D. luna* has appeared infrequently in the Balcatta Bore No. 1, between 220 and 270 feet (B. E. Balme sample No. 1479). It was originally recorded from an Upper Albian to Cenomanian deposit at Gingin, Western Australia (Wapet's seismic shothole B1 at 210 feet). The occurrence of *D. luna* in a Cretaceous sample from Graham Island, Arctic Canada is of interest (Manum and Cookson 1964).

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